Editorial

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Journal of Pathogen Research

2018
Vol.1 No.1:1

CRISPR, A Potential Powerful Weapon to Fight Potato Spindle Tuber Viroid

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Received date: January 08, 2018; **Accepted date:** January 09, 2018; **Published date:** January 11, 2018

Citation: Dianqiu LV, Xiaobao Y (2018) CRISPR, A Potential Powerful Weapon to Fight Potato Spindle Tuber Viroid. J Pathogen Res Vol 1 No.1:1.

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CRISPR/Cas9 is the third-generation technology for genome editing. CRISPR/Cas systems were found in bacteria as the immunity system to cope with the invading DNA viruses by cleaving them in a sequence dependent manner at first. Now, CRISPR/Cas9 was used to edit plant genome by instruction of double-strand DNA breaks in a sequence specific manner. This technology was applied to many plant species, such as Arabidopsis, tobacco, rice, citrus etc. [1]. It is very exciting to find that CPRSPR technology can be used for editing RNA [2,3]. At first, the class 2 type IV RNA-guide RNA-targeting CRISPR-Cas effector Cas13a was showed that it could be used to knockdown or track RNA in mammalian and plant cells. The advantage of CRISPR-Cas13a over RNAi is better specificity [2]. CRISPR-Cas13b improved the knockdown efficiency greatly over CRISPR-Cas13a. Furthermore, a system of RNA editing (REPAIR) was developed based on catalytically-inactive Cas13 in mammalian cells [3]. Because CRISPR-Cas13 can knockdown RNA in plant cell, so it is possible that it can be used to control RNA pathogen in plant which is resistant to RNAi, such as potato spindle tuber viroid (PSTVd).

PSTVd is the causal agent of potato disease of potato spindle tuber. Potato and tomato are the natural hosts for PSTVd. PSTVd is a small non-coding single-strand circle RNA molecule. PSTVd replicates in the nuclei of effected plant cell by taking advantage of host RNA dependent RNA polymerase II. The symptoms of potato spindle tuber vary dramatically. Some infected potato showed severe disease symptom, such as growth inhibition even cease entirely. But, some potato did not show noticeable growth inhibition. PSTVd can be transmitted by many ways, including mechanical transmission, vegetative propagation, aphid transmission and seeds production. The disease managements include prevention of infection and viroid eradication. Till now, there is no resistant potato cultivar for PSTVd [4].

RNA interference (RNAi) is a powerful weapon of plant to fight RNA virus or viroid infection. Double strand RNA is cleaved by Dicer-like protein into small interference RNAs (siRNAs), and the antisense siRNAs incorporate into RNA-induced silencing complex (RISC) in cytoplasm. RISC cuts the complimentary RNA in a sequence specific manner by argonaute protein which is the main component of RISC. RNA dependent RNA polymerase can synthesis double strand RNA to amplify the gene silencing [5]. RNAi was used to control PSTVd by expression the hairpin structure of PSTVd. But, some of the transgenic plants showed the disease symptoms and the mature PSTVd was resistant to RNAi [6].

Since PSTVd replicates in plant nuclei and the mature PSTVd is resistant to RNAi, therefore, CRIPSR-Cas13 could be applied to disease management by transgenic approach potentially. Moreover, the disease resistance may be amplified by RNAi after PSTVd being cleaved by CRISPR-Cas13. CRIPSR-Cas13 has advantage of higher specificity over RNAi, and the cleaved RNA may be further processed by RNAi to achieve the better disease resistance. In summary, CRIPSR-Cas13 is a new tool to knockdown RNA with better specificity than RNAi, and it may confer plant stronger disease resistance due to the synergistic effect of RNAi.

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